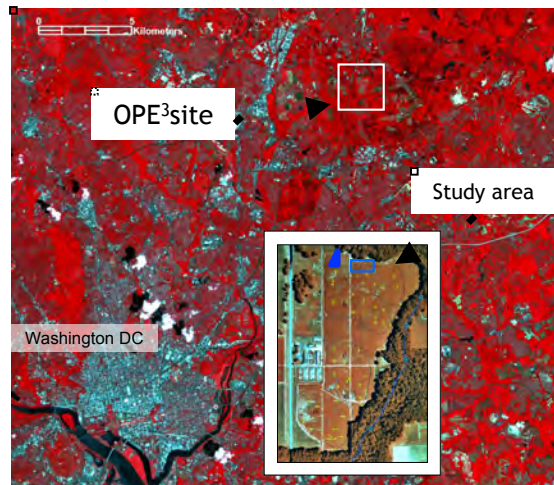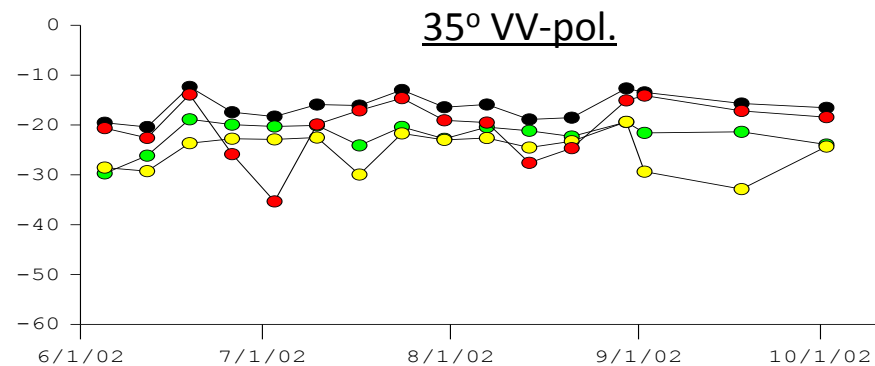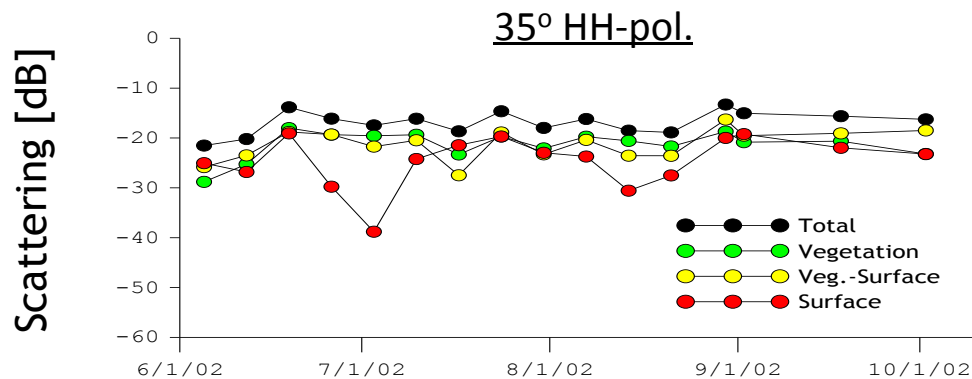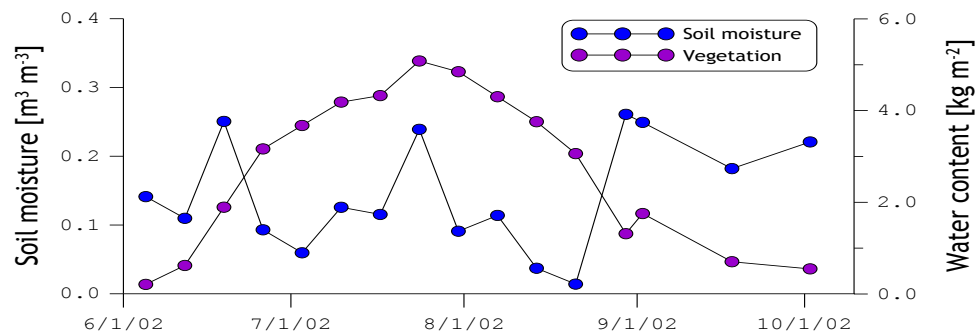# Application of the Tor Vergata scattering model to L-band backscattering over corn

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Figure 1: Study area at the OPE[3] site on the grounds of the BARC (Beltsville, MD USA)

Figure 2: Scattering contributions at 35 degrees.

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Abstract:

This study compares the L band backscatter measurements with simulations by the Tor Vergata model (Ferrazzoli and Guerriero 1996). The results from this study show that a physically based scattering model with the appropriate parameterization can accurately simulate backscatter measurements and, as such, have the potential of being used for the retrieval of biophysical variables (e.g. soil moisture and vegetation biomass).

References:

Bracaglia, M., et al. (1995). A fully polarimetric multiple scattering model for crops. Remote Sensing of Environment, 54(3), 170-179.

Della Vecchia, A., et al. (2006). Simulating L-band emission of coniferous forests using a discrete model and a detailed geometrical representation. IEEE Geoscience and Remote Sensing Letters, 3(3), 364-368.

Joseph, A.T. et al. (2010). Effects of corn on C- and L-band radar backscatter: A correction method for soil moisture retrieval. Remote Sensing Environment, DOI: 10.1016/j.rse.2010.05.017

Chauhan, N. S., Le Vine, D. M., & Lang, R. H. (1994). Discrete scatter model for microwave radar and radiometer response to corn: comparison of theory and data. Geoscience and Remote Sensing, IEEE Transactions on, 32(2), 416-426.

Data Sources:

This research has been conducted using the data set collected during the 2002 corn growth cycle at OPE[3] site near Beltsville (Maryland, USA). Continuity was assured via a field campaign in 2012 with the ComRad radar/radiometer system, which is also designed for SMAP Cal/Val activities. 2013 and 2014 ComRad field campaigns are being planned.

Technical Description of Figures:

Figure 1: An aerial image of the study area at the OPE[3] site on the grounds of the USDA-BARC (Beltsville, MD USA).

Figure 2: Shows analysis and results of scattering contributions at 35 degrees.

Scientific significance:

Both the vegetation cover and the soil surface affect microwave measurements. A thorough understanding of these effects is needed to achieve the optimum accuracy for retrievals related to the soil and vegetation. In this study, the measured soil moisture, vegetation biomass and reliably measured vegetation morphological parameters were used as input for the Tor Vergata model. The calibrated Tor Vergata model simulations are in excellent agreement with the measurements of Root Mean Squared Differences (RMSD's) for incidences of 15, 35 and 55 degrees, respectively.

Relevance for future science and relationship to Decadal Survey:

In the Decadal Survey, global soil moisture monitoring from space has been identified as a top priority because it will have applications in numerical weather prediction, drought monitoring and flood forecasting. Soil moisture retrieval over a wide range of vegetated conditions require accurate remote sensing observations. Currently, the NASA has launched and is preparing to launch missions carrying both passive and active L-band microwave sensors: Aquarius (launched in 2011) and Soil Moisture Active Passive (SMAP, expected launch in 2014).
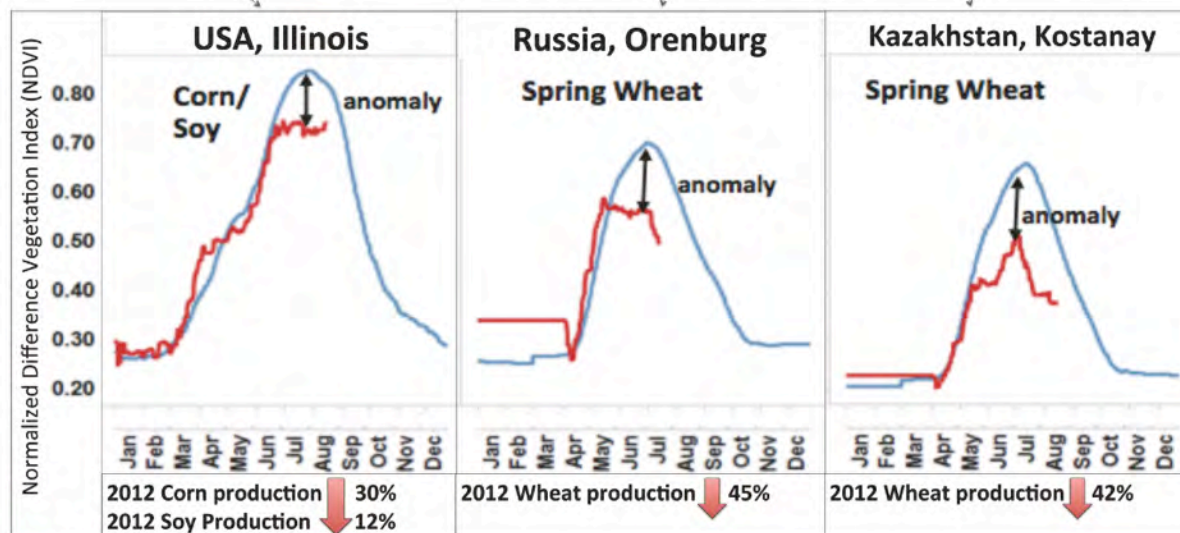
Using MODIS daily data as input to G20- GEOGLAM Crop Outlook Assessments
Eric Vermote, Code 619, NASA GSFC
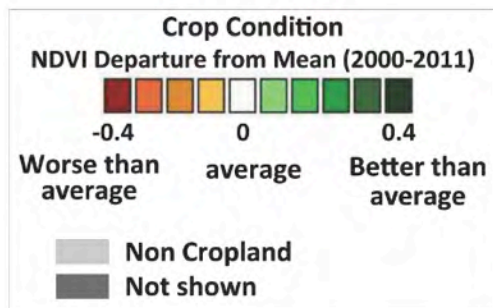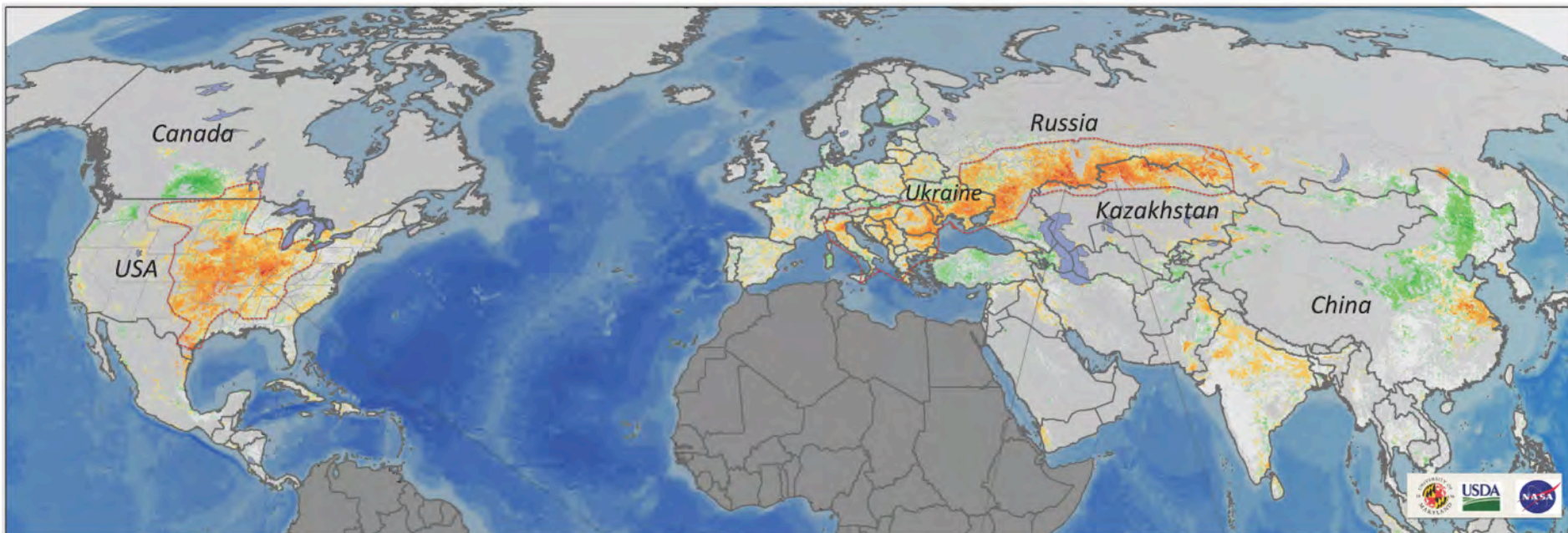
Figure: 2012 Northern Hemisphere Drought

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Abstract:
There is a growing demand for timely, transparent, reliable global information on crop prospects particularly given the recent crop price spikes which were largely driven by shortfalls due to extreme weather events such as droughts. As a result, in 2011, the GEOGLAM (Group on Earth Observations Global Agricultural Monitoring) initiative was adopted by the G20 as part of the Ministers of Agriculture Action Plan on Food Price Volatility and Agriculture. One of the activities under this initiative is to develop monthly, consensus global crop outlooks that highlight areas of concern in the primary crop producer/export due to factors such as droughts. These outlooks are being developed in response to a request from the G-20 Agricultural Market Information System (AMIS). Researchers at NASA in collaboration with University of Maryland and USDA are leading this activity, and are utilizing MODIS daily vegetation index anomalies in conjunction with crop type masks, crop statistics, and crop calendars to develop timely indicators on crop conditions and prospects. These data a key element in initiating and developing the GEOGLAM crop outlook prototypes that will be produced on an operational basis for AMIS starting in September 2013 and have been presented at the G-20 AMIS meeting in Paris (April 2013) and at the G-8 meeting on open data for Agriculture in DC (April 2013).

References:

Breon, F.M., & Vermote, E. (2012). Correction of MODIS surface reflectance time series for BRDF effects. **Remote Sensing of Environment**, 125, 1-9.
GEO-Agriculture. 2012. GEOGLAM: The G-20 GEO Global Agricultural Monitoring Initiative submitted to the G-20 Agriculture Ministers on March 23, 2010. Geneva.
Inbal Becker-Reshef, Chris Justice, Mark Sullivan, Eric Vermote, Compton Tucker, Assaf Anyamba, Jen Small, Ed Pak, Ed Masuoka, Jeff Schmaltz, Matthew Hansen, 3, Kyle Pittman, Charon Birkett, Derrick Williams, Curt Reynolds and Bradley Doorn , 2010, Monitoring Global Croplands with Coarse Resolution Earth Observations: The Global Agriculture Monitoring (GLAM) Project **Remote Sensing**, 2(6), 1589-1609;doi:10.3390/rs2061589 .

Data Sources: The data were produced by the MODIS Adaptive Processing System and the LTDR system (Code 619) and are available with documentation from http://ltdr.nascom.nasa.gov/

Technical Description of Figures:

Figure 1: The anomaly image shows the cropland NDVI departure from Average (2000-2011) on July 30th 2012 highlighting hotspots of crops under stress during the 2012 droughts that affected the United States and the Black Sea region.. The time series curves below compare the daily development of croplands in 2012 (red) to average (2000-2011) in 3 important crop growing regions: Illinois, USA; Orenburg Oblast, Russia; Kostanay Oblast, Kazakhstan. The crop development through the season depicted by NDVI shows consistent negative anomalies with regard to a ten year average, with highest discrepancies during the crops peak development period. In 2012 crops in the US, southern Europe and the Black Sea region suffered from prolonged high temperatures and lack of moisture, which resulted in significantly reduced production. This information was available one month prior to harvest and several months before the release of official statistics.

Scientific significance: Remote sensing data offer the only practical means for providing global, timely, cost-effective, and synoptic information on crop condition, stress and distribution. Their utility for crop monitoring and early warning has long been recognized and demonstrated across a wide range of scales and geographic regions

Relevance for future science and relationship to Decadal Survey: With increasing occurrence of extreme weather events such as droughts and the increasing demand for food, satellite information is critical in providing early indication on crop prospects and alert of shortfalls.